

NEC-2370-US  
Amendment dated 05/19/2004

09/853,622

04150012aa  
Reply to office action mailed 04/21/2004

The following is a complete listing of all claims in the application, with an indication of the status of each:

Listing of claims:

- C19
- 1 1. (currently amended) A magnetoresistive effect sensor using a shielded-  
2 type magnetoresistive effect element comprising:  
3 a magnetoresistive effect film above a lower shield layer, said film  
4 comprising a basic configuration that is a combination of a free layer, a barrier  
5 layer, and a fixed layer, wherein either a combination of a free layer, a said  
6 barrier layer is formed on said free layer, and a said fixed layer is formed on  
7 said barrier layer, or a combination of a fixed layer, a said barrier layer is  
8 formed on said fixed layer, and a said free layer is formed on said barrier  
9 layer, said barrier layer inheriting a roughness of said lower shield layer,  
10 wherein a sensing current flows substantially perpendicularly with respect to  
11 said magnetoresistive effect film, and wherein either an amorphous material or  
12 a microcrystalline material is used in a said lower shield layer so as to smooth  
13 said lower shield layer, thereby increasing the smoothness of said barrier layer.
  - 1 2. (original) A magnetoresistive effect sensor according to claim 1, wherein  
2 said lower shield comprises a crystal grain diameter of 6.2 nm or smaller.
  - 1 3. (currently amended) A magnetoresistive effect sensor according to claim 1  
2 or claim 2, wherein said lower shield is made of a material of CoZrTa, with a  
3 and CoZrTaCr alloy, serving as a base layer for said free layer.
  - 1 4. (withdrawn) A magnetoresistive effect sensor according to claim 1,  
2 wherein said lower shield is formed by means of sputtering.

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1 5. (withdrawn) A magnetoresistive effect sensor according to claim 1,  
2 wherein a magnetoresistive effect film having a basic configuration that is  
3 either a combination of a free layer, a barrier layer formed on said free layer,  
4 and a fixed layer formed on said barrier layer, or a combination of a fixed  
5 layer, a barrier layer formed on said fixed layer, and a free layer formed on  
6 said barrier layer is formed on said lower shield directly or formed thereon via  
7 an intervening base layer.

1 6. (withdrawn) A magnetoresistive effect sensor according to claim 1,  
2 wherein a lower conductor layer is disposed at a bottom part of a  
3 magnetoresistive effect film having a basic configuration that is either a  
4 combination of a free layer, a barrier layer formed on said free layer, and a  
5 fixed layer formed on said barrier layer, or a combination of a fixed layer, a  
6 barrier layer formed on said fixed layer, and a free layer formed on said barrier  
7 layer, a bottom part of said lower conductor layer being in contact with a  
8 lower shield.

1 7. (withdrawn) A magnetoresistive effect sensor wherein in a  
2 magnetoresistive effect element in which a conductor layer is disposed at a  
3 bottom part of a magnetoresistive effect film having a basic configuration that  
4 is either a combination of a free layer, a barrier layer formed on said free layer,  
5 and a fixed layer formed on said barrier layer, or a combination of a fixed  
6 layer, a barrier layer formed on said fixed layer, and a free layer formed on  
7 said barrier layer, in contact either with an intervening base layer or directly  
8 therewith, wherein said lower conductor layer functions as a lower electrode to  
9 cause a sensing current to flow in said magnetoresistive effect film, and

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10 further wherein a lower conductor is made of a material selecting from a group  
1 consisting of an amorphous material and a microcrystal.

1 8. (withdrawn) A magnetoresistive effect sensor according to claim 7,  
2 wherein said microcrystal forming said lower conductor layer comprises a  
3 crystal grain diameter of 5.4 nm or smaller.

1 9. (withdrawn) A magnetoresistive effect sensor according to claim 7,  
2 wherein said lower conductor layer is formed by sputtering.

1 10. (withdrawn) A magnetoresistive effect sensor according to claim 1,  
2 further comprising a layer which fixes a magnetization of a fixed layer,  
3 provided so as to be in contact with said fixed layer.

1 11. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor whereby a shielded-type magnetoresistive effect element in which a  
3 sensing current flows substantially perpendicular to a magnetoresistive effect  
4 film, using a magnetoresistive effect film having a basic configuration that is  
5 either a combination of a free layer, a barrier layer formed on said free layer,  
6 and a fixed layer formed on said barrier layer, or a combination of a fixed  
7 layer, a barrier layer formed on said fixed layer, and a free layer formed on  
8 said barrier layer, wherein a material selected from a group consisting of an  
9 amorphous material and a microcrystalline material is used in a lower shield.

1 12. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor according to claim 11, wherein said microcrystal used in said lower  
3 shield comprises a crystal grain diameter of 6.2 nm or smaller.

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13. (withdrawn) A method for manufacturing a magnetoresistive effect sensor according to claim 11, wherein said lower shield is formed using sputtering.

1 14. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor according to claim 11, wherein a magnetoresistive effect film having a  
3 basic configuration that is either a combination of a free layer, a barrier layer  
4 formed on said free layer, and a fixed layer, or a combination of a fixed layer,  
5 a barrier layer formed on said fixed layer, and a free layer is formed on said  
6 lower shield directly or formed thereon via an intervening base layer.

1 15. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor according to claim 11, whereby a lower shield layer is formed and a  
3 lower conductor layer is formed on said lower shield layer, and further  
4 whereby a magnetoresistive effect film having a basic configuration that is  
5 either a combination of a free layer, a barrier layer formed on said free layer,  
6 and a fixed layer, or a combination of a fixed layer, a barrier layer formed on  
7 said fixed layer, and a free layer formed on said barrier layer is formed on said  
8 lower conductor layer, either directly or via an intervening base layer.

1 16. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor whereby a magnetoresistive effect film having a basic configuration  
3 that is either a combination of a free layer, a barrier layer formed on said free  
4 layer, and a fixed layer, or a combination of a fixed layer, a barrier layer  
5 formed on said fixed layer, and a free layer formed on said barrier layer is  
6 formed either directly on a lower conductor layer or thereonto with an  
7 intervening base layer, and further wherein, said lower conductor layer being

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made of a material selected from a group consisting of an amorphous material and a microcrystalline material.

1 17. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor according to claim 16, whereby said lower conductor layer is formed by  
3 a microcrystal comprising a crystal grain diameter of 5.4 nm or smaller.

1 18. (withdrawn) A method for manufacturing a magnetoresistive effect  
2 sensor according to claim 16, whereby said lower conductor layer is formed by  
3 sputtering.

1 19. (withdrawn) A method for manufacturing a magnetoresistive effect film  
2 according to claim 11, whereby a layer fixing a magnetization of a fixed layer  
3 is further formed, so as to be in contact with said fixed layer.

1 20. (withdrawn) A magnetoresistance detection system comprising a  
2 magnetoresistive effect sensor according to claim 1, a means for generating a  
3 current passing through a magnetoresistive effect sensor, and means for  
4 detecting a change in magnetoresistance of said magnetoresistive effect sensor  
5 as a function of a detected magnetic field.

1 21. (withdrawn) A magnetic recording system comprising a magnetic storage  
2 medium comprising a plurality of tracks for data recording, a magnetic  
3 recording system for storing data on said magnetic storage medium, a  
4 magnetoresistance detection system according to claim 20, and an actuating  
5 means lined to said magnetic recording system and a magnetoresistance  
6 conversion system for the purpose of causing said magnetic recording system

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and said magnetoresistance detection system to move to a selected track of  
said magnetic storage medium.

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